Fully Integratable THz Transmitters in Nanometer CMOS

Wouter STEYAERT[1], Patrick REYNAERT[1]

[1]*Department of Electrical Engineering (ESAT-MICAS), KU Leuven, Leuven, Belgium*
Email:{wouter.steyaert; patrick.reynaert}@esat.kuleuven.be, web site: http://www.esat.kuleuven.be/micas/

Thanks to continuous research efforts, many possible applications and user cases have been defined for the THz spectrum. While THz systems start to penetrate the research and industrial markets, a breakthrough in the consumer market would require THz circuits implementable in Silicon technologies: CMOS technology [1] would allow cheap, compact and high-yield manufacturable circuits which can be fully integrated with the necessary digital signal processing chips [2]. This would enable the widespread usage of THz chips in a multitude of consumer products as well as industrial applications. However, CMOS technology suffers from some initial roadblocks for sub-mmwave operation: reduced maximum frequency of oscillation (fmax) and limited voltage headroom and output power.

In this talk, we will highlight the problems that stand in the way of THz transmitters in CMOS and discuss possible solutions and workarounds when designing and implementing Fully Integratable THz transmitters in nanometer CMOS technology [3-4]. With the increasing operation frequency, getting the generated signals off-chip becomes an additional concern. Bondwires attenuate the signal too much, while high-frequency probes are only usable in a research environment. For any practical application, on-chip antennas should be included in the design process. We will discuss both the circuit design as well as packaging/antenna design for a 570GHz and 600GHz transmitter in a 28nm CMOS technology. Measurement results of some of these THz chips will be presented, as well as the application of these THz CMOS transmitters in the non-destructive quality control of surgical needles which gains from the high possible spatial resolution that comes with the use of sub-mm wave frequencies.

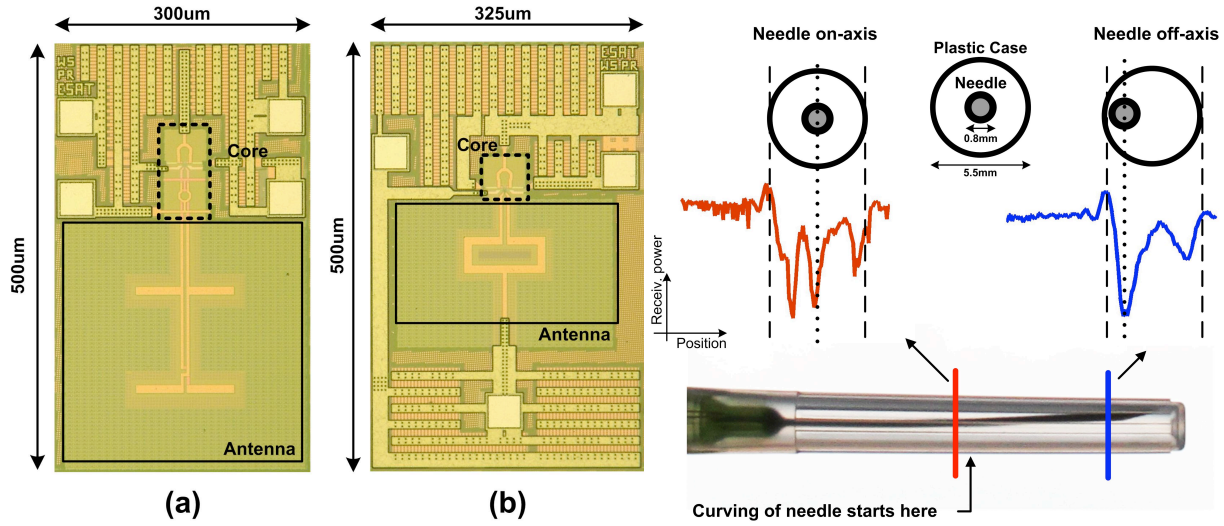

Fig1. Chip photograph of a 570 GHz (a) and 600 GHz (b) transmitter implemented in a 28nm CMOS technology. These chips are used in a measurement setup for non-destructive quality control of surgical needles (right).

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